

# PATENT SPECIFICATION

DRAWINGS ATTACHED

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## COMPLETE SPECIFICATION

### Filters for Liquids

5 We, GENERAL MOTORS LIMITED, a British Company of 23 Buckingham Gate, London S.W.1., do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is to be performed to be particularly described in and by the following statement:—

10 This invention relates to filters for liquids and in particular to oil filters for internal combustion engines; the invention is especially suitable for so-called "screw-on" filter units in which a filter element is housed in a thin sheet metal casing having an end plate with a threaded portion adapted to be engaged with a complementary threaded portion of a mounting for the filter, the whole filter unit being discarded and replaced by a new unit when the filter element has become blocked.

20 In a liquid filter unit according to the present invention opposite sides of an annular filter element are placed in communication with inlet and outlet openings respectively at one end of the filter casing by means of a seal member which also constitutes a non-return valve, and a relief valve arranged adjacent the seal member to permit a by-pass flow of liquid between the inlet and outlet openings at said end when the pressure within the filter casing exceeds a predetermined value.

30 Preferably the movable member of the relief valve forms part of the seal member, but may also be separate therefrom. A preferred relief valve includes a valve member which is movable radially of the unit when the predetermined pressure within the casing is exceeded.

40 The seal member is preferably an annular member of synthetic rubber or like material opposite end faces of which respectively engage the end plate of the casing about an outlet opening therein, and one end of the filter element about the central passage therethrough,

the seal member having an integral outwardly extending annular flange arranged so as normally to overlie and close one or more inlet openings in said end plate. The flange is adapted to be resiliently deflected under the pressure of the liquid delivered to the filter through the inlet openings, when the filter is in use, but when the filter is not in use to overlie the inlet openings to prevent unfiltered liquid draining back from the inlet side of the filter.

55 The relief valve has an annular portion adapted to fit within and form a seal with one end of the annular filter element; the other end of the element is closed by a closure member which fits within and seals the other end of the filter element and preferably also presses said one end of the element and the seal member towards said end plate. The closure member may be in the form of a metal plate with a circular recessed portion adapted to fit in said other end of the element and with integral resilient fingers adapted to engage the other end of the filter casing so as to press the filter element with the seal member in engagement with said end plate. Alternatively the closure member may be a member of synthetic rubber or like material adapted to fit in said other end of the element and formed with integral portions adapted to engage the other end wall of the casing under axial compression so as to press the filter element with the seal member into engagement with said end plate.

75 Preferably the annular filter element is made of a strip of synthetic-resin impregnated filter paper or like sheet filter material folded so as to form a series of pleats in which the fold lines extend longitudinally of the annulus; and the pleats are preferably each sealed at opposite ends thereof separately from adjacent pleats. Alternatively or additionally the ends of the pleats may be sealed to end caps.

[1] [2]

The scope of the invention is defined by the appended claims; and the invention and the method by which it is to be performed are hereinafter particularly described with reference to the accompanying drawings in which:—

Figure 1 is a vertical section through one embodiment of a filter unit according to the invention;

Figure 2 is a vertical section through a second embodiment of a filter unit according to the invention;

Figure 3 is a detail, to an enlarged scale of Figure 2;

Figure 4 is a vertical section through a third embodiment of a filter unit according to the invention;

Figure 5 is a detail to a larger scale of Figure 4;

Figure 6 is a vertical section through the lower end of a filter unit according to the invention, showing an alternative method of sealing an end of the filter element; and

Figures 7 and 8 are views similar to Figure 6 showing two further methods of sealing an end of the filter element.

Like parts in the drawings bear similar reference numerals.

The filter unit shown in Figure 1 comprises an annular filter element 1 arranged in a filter casing 2 made as a cup-shaped shell 3 of thin sheet metal at the open end of which is secured a circular end plate 4 of thicker gauge metal having a central opening 5 in a neck portion 6 thereof which is internally threaded for engagement with a complementary threaded portion of a mount face (not shown) to which the filter unit is to be secured. The end plate 4 is secured to the open end of the shell by means of an annular disc 7 of thin sheet metal which is secured coaxially with the end plate 4 by welding, brazing or the like. The outer peripheral portion of the annular disc 7 is secured to the end of the shell 3 by a rolled seam joint 8, the end plate 4 being axially off-set, towards the base of the shell 3, from the rolled seam joint 8. The portion of the annular disc 7 adjacent the rolled seam joint is of trough shape and has therein an annular gasket 9.

Around the central opening 5 in the end plate 4 is a circular series of openings 10 which constitute the inlet to the filter unit. Extending around the neck 6 on the end plate 4 is an annular seal member 11 of synthetic rubber or like material with an integral outwardly extending flange 12 which normally overlies and seals the inlet opening 10 in the end plate 4 and acts as a non-return valve. The seal member 11 has a short coaxial neck 14 on which fits a relief valve comprising a stepped tubular metal valve housing 15 the smaller diameter end 16 of which is adapted to fit within the seal against one end of the annular filter element 1. In the annular wall

17 of the relief valve housing 15 is a circular series of holes 18 which are closed off by an annular valve ring 19 of synthetic rubber or like material which fits within the valve housing 15 under compression.

The other end of the annular filter element 1 is sealed by a closure member comprising a metal plate 20 a central circular portion 21 of which is dished to fit within the end of the annular filter element, the plate having integral radial spring arms 22 the ends of which engage the base of the shell 3 so as to press the opposite end of the filter element with the relief valve 15, 19 therein, into engagement with one side of the annular seal member 11.

In use, the filter unit is secured to a mount face, for example on an internal combustion engine, by screwing the threaded neck 6 of the end plate 4 on to a threaded hollow boss which protrudes from the mount face, the annular gasket 9 on the end plate 4 thereby being brought into sealing engagement with an annular seat on the mount face about a recessed portion in which is an outlet passage forming part of the engine lubrication system. Oil from the outlet passage enters the filter by way of the inlet openings 10 in the end plate 4, the flange 12 on the seal member 11 being resiliently deflected, and after passing through the filter element is returned to the lubrication system by way of the central passage in the filter element and the central opening 5 in the neck 6. When the filter element 1 becomes clogged the pressure within the filter casing 2 increases until, at a predetermined pressure, the rubber ring 19 of the relief valve 15 is deflected radially inwards permitting oil to pass through the openings 18 in the relief valve housing 16 and from thence direct to the inlet passage on the mount face by way of the central opening 5, the filter element 1 thus being by-passed.

The arrangement of the relief valve 15 at the same end of the filter element as the flange 12 which forms the non-return valve ensures that, when the filter unit is mounted with the base of the cup-shaped shell 3 downmost, as is frequently the case, the by-pass flow of liquid within the filter casing, when the relief valve 15, 19 is operating, does not entrain sludge particles which are deposited on the outside of the filter element and which tend to accumulate on the base of the filter casing.

In the second embodiment of the invention shown in Figures 2 and 3 the seal member is formed as a member 25 which is of generally similar construction to that shown in Figure 1 but has an axially extending neck 26 extending from the central portion 27 thereof and a radial flange 28 which, as in the previous embodiment, overlies the inlet openings 10 and forms a non-return valve. The relief valve in this embodiment is formed by the co-operation of the neck 26 on the seal member 25 with a tubular valve member 30 of synthetic

rubber or like material which has an external flange 31 intermediate its ends. One end of the valve member 30, and the adjacent side of the flange 31 respectively fit within and against the upper end of the filter element 1 to form a seal therewith; and the other end of the valve member 30, and the other side of the flange 31 are formed with castellations 32 so as to permit the pressure of the liquid within the filter casing 2 to be applied to the extended neck portion 26 of the seal member 25.

In operation, when the pressure of the liquid within the filter casing 2 exceeds a predetermined value the extended neck portion 26 of the seal member 25 is inwardly deflected to break the seal between it and the tubular valve member 30 and thereby permit the liquid to be filtered to pass through the castellations 32 and around the deflected neck portion 26 of the seal member 25 and from thence direct to the central opening 5 in the neck 6 of the end plate 4. The positions of the members 26 and 28 of the relief valve and non-return valves, when deflected, are shown in broken lines in Figures 3.

In a third embodiment of the invention shown in Figures 4 and 5 the movable member of the relief valve is similarly formed as an integral extended neck 40 on a seal member 41 which also has an integral radial flange 42 which normally overlies the inlet openings 10 and acts as a non-return valve. In this embodiment, castellations 43 by which, as in the embodiment shown in Figures 2 and 3, the liquid within the filter casing 2 has access to the extended neck 40 of the relief valve, are formed integral with the seal member 41, the castellations 43 extending round the axially extended neck 40 of the seal member 41 and being slightly radially spaced therefrom. In order to seal off the one end of the filter element 1 an annular sheet metal pressing 44 of inverted L shape in section is used, the pressing having a tubular portion which fits within the open end of the element and an integral radial flange which abuts the end of the element. The extended neck 40 on the seal member 41 fits within the tubular portion of the pressing 44 and the integral castellations 43 on the seal member 41 abut the flange of the pressing 44.

In operation (see Figure 5), when the pressure of the liquid within the filter casing 2 exceeds a predetermined value the extended neck 40 on the seal member 41 is inwardly deflected so as to be unseated from the metal pressing 44 and permit liquid to pass direct from the inlet openings 10 to the central outlet 5 in the boss 6 of the end plate 4.

Instead of sealing the other end of the filter element with the dished metal closure member 20, shown in Figure 1, the closure member may also be formed of synthetic rubber or like material, for example in the form of a plug 50 which, as shown in Figure

2, fits within and seals against the lower end of the filter element and has integral axially extending bosses 51 which are axially compressed, when the filter unit is assembled, so as to press the filter element 1 into engagement with the seal and valve members 25, 26.

Alternatively, as shown in Figure 6, the closure member may be a tubular member 60 having an external shoulder 61 to seal against the end of the element 1 and an axial extension 62 to seal against the end of the filter casing 2.

In a further alternative shown in Figure 7 the closure member comprises a square pad 70 of closed-cell foam rubber or like material which is compressed between the lower end of the filter element 1 and the base of the filter casing 2. The square shape of the pad locates the pad in the circular filter casing and permits free flow of the liquid to be filtered around the ends of the pleated filter element.

In yet another alternative form of construction the closure for the other end of the element is formed, as shown in Figure 8, by a recessed end portion 80 of the filter casing 2 which fits within and seals against the lower end of the filter element 1. The relative axial dimensions of the element, the casing and the seal member at the upper end of the element 1 are such that the seal member will be under slight axial compression.

It will be understood that in all the embodiments of the invention described above the internally threaded, inwardly extending neck 6 on the end plate 4 could be replaced by an externally threaded, outwardly extending neck which would be screwed into a threaded opening in a mount face for the filter.

#### WHAT WE CLAIM IS:—

1. A liquid filter unit in which opposite sides of an annular filter element are placed in communication with inlet and outlet openings respectively at one end of the filter casing by means of a seal member which also constitutes a non-return valve, and a relief valve is arranged adjacent the seal member to permit a by-pass flow of liquid between the inlet and outlet openings at said end when the pressure within the filter casing exceeds a predetermined value.

2. A filter unit according to claim 1, in which the movable member of the relief valve forms part of the seal member.

3. A filter unit according to claim 1, in which the movable member of the relief valve is separate from said seal member.

4. A filter unit according to claim 2 or 3, in which the relief valve includes a valve member movable radially of the unit when said predetermined pressure is exceeded.

5. A filter unit according to any of claims 1 to 4, in which the filter element is housed in a thin sheet metal casing having an end plate with a threaded portion adapted to be

engaged with a complementary threaded portion of a mounting for the filter, said end plate having therein a central outlet opening in said threaded portion and one or more inlet openings in the end plate about said outlet opening.

5 6. A filter unit according to claim 5, in which the seal member is an annular member of synthetic rubber or like material the opposite end faces of which respectively engage the  
10 end plate about the outlet opening therein, and one end of the filter element about the central passage therethrough, the seal member having an integral outwardly extending annular flange arranged so as normally resiliently to  
15 overlie and close said inlet openings.

7. A filter unit according to claim 6, in which the relief valve has an annular portion adapted to fit within and form a seal with one  
20 end of the annular filter element, the other end of the element being closed by a closure member which fits within and seals the other end of the element.

8. A filter unit according to claim 7, in which said closure member also presses said  
25 one end of the element and the seal member towards said end plate.

9. A filter unit according to claim 8, in which the closure member is a metal plate with a circular recessed portion adapted to fit in  
30 said other end of the element and with integral resilient fingers adapted to engage the other end of the filter casing so as to press the element and the seal member into engagement with said end plate.

10. A filter unit according to claim 8, in which the closure member is of synthetic rubber or like material and has a portion adapted to fit in said other end of the element to seal the latter and integral portions adapted  
40 to engage the other end wall of the casing under axial compression so as to press the filter element with its seal member in engagement with said end plate.

11. A filter unit according to claim 8, in which said closure member comprises a pad of square or other non-circular shape made of closed-cell foam rubber or like material which is compressed between said other end of the filter element and the other end wall of the casing.  
50

12. A filter unit according to claim 8, in which the closure member is formed by a recessed end portion of said other end wall of the filter casing, the relative axial dimensions of the element, the casing and the cell member being such that the seal member is under slight axial compression.  
55

13. A filter unit according to any of claims 6 to 12, in which the relief valve fits on to  
60 a co-axial neck on said seal member and

comprises a stepped tubular metal valve housing the smaller diameter end of which fits within and seals against one end of the filter element, said valve housing having a circular series of holes in its annular wall closed by a ring of synthetic rubber or like material which fits under compression within the valve housing, said valve ring being displaceable radially inwards to permit by-pass flow of liquid through the holes when said predetermined pressure within the housing is exceeded. 65

14. A filter unit according to any of claims 6 to 12, in which said seal member has a neck extending axially from a central portion thereof and the relief valve fits over said neck and is formed by the co-operation of said neck with a tubular valve member of synthetic rubber or like material having intermediate its ends an external flange, one end of the valve member and the adjacent side of the flange respectively fitting within and against an end of the filter element to form a seal therewith and the other end of the valve member and the other side of the flange being formed with castellations so as to permit liquid pressure within the filter casing to be applied to the extended neck portion of the seal member and deflect the latter to permit by-pass flow of liquid when the predetermined pressure within the casing is exceeded. 70 75 80 85 90

15. A filter unit according to any of claims 6 to 12, in which said relief valve is formed integral with said seal member, the seal member having an annular castellated portion which engages an end of the filter element and an integral neck which extends within said end of the filter element and is deflected radially inward by the pressure of fluid applied through said castellations when said predetermined pressure within the casing exceeded. 95 100

16. A filter unit substantially as hereinbefore particularly described and as shown in Figure 1 of the accompanying drawings.

17. A filter unit substantially as hereinbefore particularly described and as shown in Figures 2 and 3 of the accompanying drawings. 105

18. A filter unit substantially as hereinbefore particularly described and as shown in Figures 4 and 5 of the accompanying drawings.

19. A filter unit substantially as hereinbefore particularly described and as shown in Figure 6 of the accompanying drawings. 110

20. A filter unit substantially as hereinbefore particularly described and as shown in Figure 7 of the accompanying drawings. 115

21. A filter unit substantially as hereinbefore particularly described and as shown in Figure 8 of the accompanying drawings.

E. WILLIAMSON,  
Chartered Patent Agent.

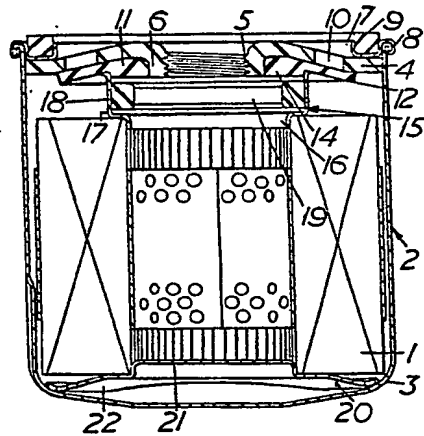


FIG. 1

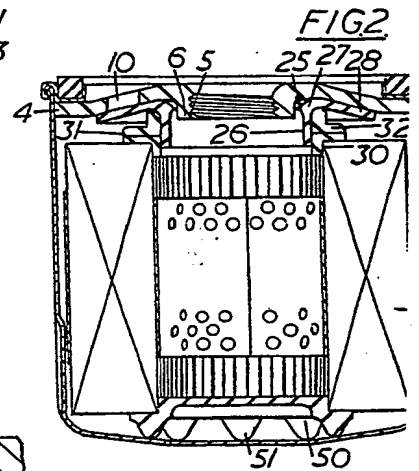


FIG. 2

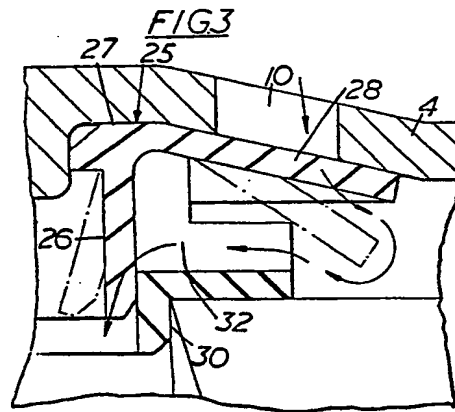


FIG. 3

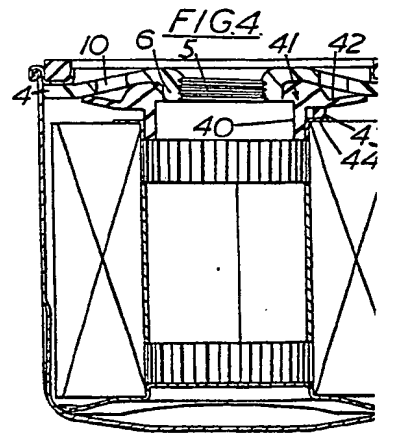


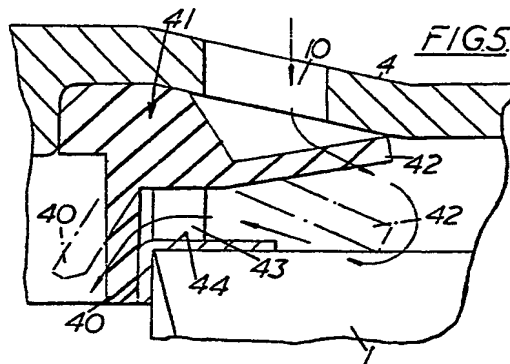
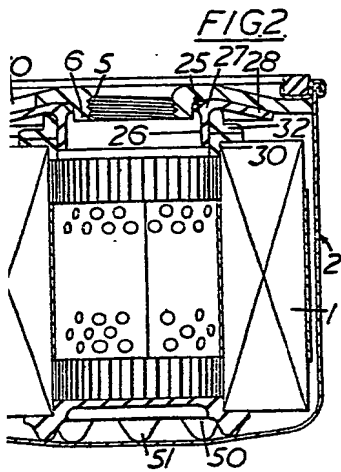
FIG. 4

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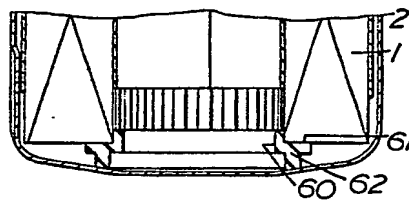
COMPLETE SPECIFICATION

2 SHEETS

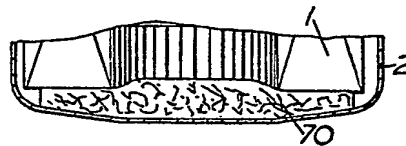
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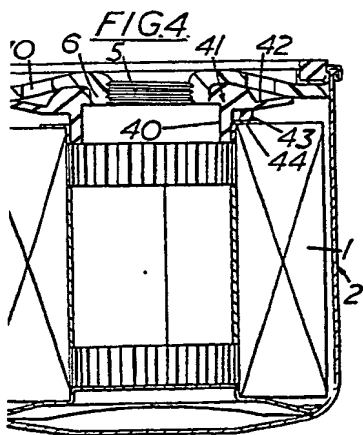
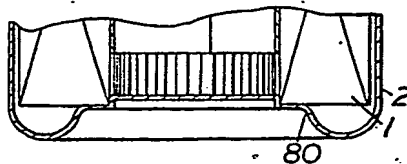
**FIG6**



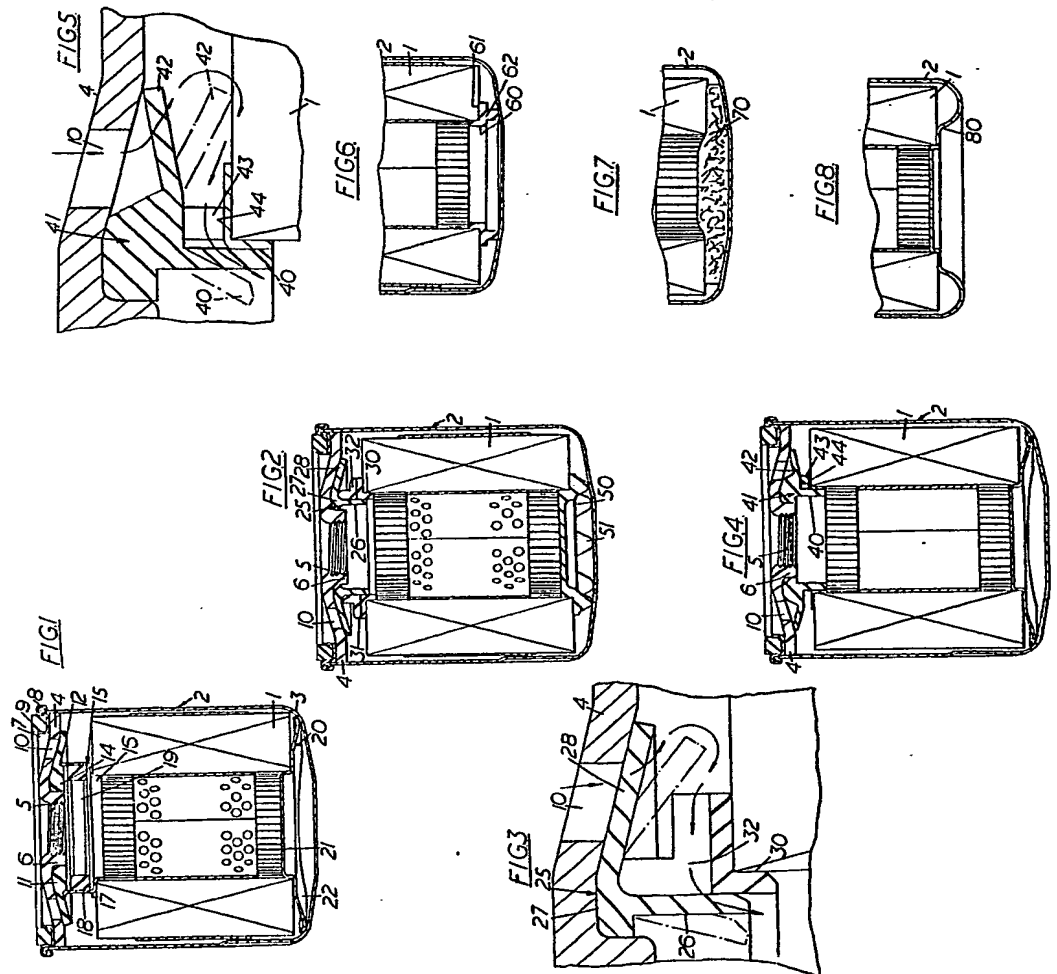
**FIG7**



**FIG8**



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